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*ZOOLOGY OF THE VERTEBRATA.*

*A Student's Text-book of Zoology.* By Adam Sedgwick, M.A., F.R.S. Vol. ii. Pp. xv+705; illustrated. (London: Swan Sonnenschein and Co., Ltd.; New York: The Macmillan Company, 1905.) Price 21s.

THE first volume of this "Student's Text-book of Zoology" was published in 1898, and dealt with the invertebrate animals except echinoderms and arthropods. It was then hoped that another volume would suffice to complete the book, but that sanguine estimate was far off the mark. After half a dozen years the second volume has been completed, thicker than the first by a hundred pages, and the echinoderms, arthropods, enteropneusts, and tunicates are still to follow. A fourth volume will be required to deal with the principles of zoology. By that time the so-called student's text-book will require another title.

The first volume has a well deserved reputation for accuracy, clearness, terseness, and independence, and in the crowd of text-books it has filled a definite place to the satisfaction of teachers as well as of students. Presupposing a knowledge of "types," it dealt with the various classes in a systematic way, giving detailed classifications and taking account of a very large number of important forms. It was a successor of Claus's "Lehrbuch," but stronger in its grip, and vastly more interesting. The second volume is like unto the first, and it has been worth waiting for.

After a short introduction on Chordata, the author deals with the lancelets; then follows a discussion of the general characters of Craniata, and so on through the vertebrate series, each class, subclass, and order having its definition and general exposition followed by small print dealing with families and genera. The definitions are models of terseness; the large-print discussions of general characters are marvels of condensation and selective insight—almost peptonised extract of zoology—and the small print is monumental in its erudition. We took the last four vertebrates that happened to come into the laboratory—a watershrew, a golden-crested wren, some young fierasfers, a specimen of *Palaeospondylus*—and for three out of this fortuitous four we found interesting information in this encyclopædic volume. There is, however, another side to this relative exhaustiveness, that the details of classification are apt to change rapidly, and that many of the implied systematic conclusions must, from the nature of the case, have been simply accepted by the author because they were well vouched for by specialists. But there does not seem to be any way out of this except refraining from the very detailed treatment which is part of the characteristic aim of the book, or else adopting the cooperative device, which is apt to mean a lack of unity. It says much for the energy of the author that the classification of teleostean fishes is substantially that worked out by Mr. Boulenger, who supplied proofs of his work before its publication.

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Leaving the question of the desirability of attempting so great exhaustiveness in what is at least called a student's text-book—a question which the gratefully recognised utility of the first volume has in part at least answered—we venture to express the hope that the final edition of the whole work will see some re-arrangement. Even unconsciously the student has what Herbert Spencer called an "architectonic" instinct; he likes some semblance of evolutionary order in his text-book. But although Mr. Sedgwick allows that enteropneusts and tunicates are chordates, they are not discussed in this volume, but must eventually be treated, we presume, at a remote distance, remote even from *Amphioxus*. Similarly, the annelids will be far away from the arthropods, and other instances might be given which suggest that the conditions of the production of this great work have not favoured its architectural plan.

Another carping criticism which we must make is this, that whereas the preface, like so many other prefaces, holds out the promise of "dealing fairly" with *habits* as well as with morphological aspects, we find after all that we have to be grateful for small mercies.

We confess also to some disappointment at the severity of Mr. Sedgwick's scientific mood, which may be illustrated, for instance, by this sentence:—

"As to its (the group *Mammalia*) origin in evolution we have nothing to say for the very good reason that there are no facts by which we can arrive at any conclusion on the subject."

(This does not, of course, refer to the affinities between *Mammalia* and other classes of vertebrates, which are briefly discussed.) Similarly, it is very difficult to discover what positive view, if any, the author holds in regard to the affiliation of Chordata to an antecedent stock. Incidentally, the author lifts just a little the veil with which he so successfully conceals his evolutionist convictions. Thus he says of the hag-fish:—

"To hold that a free-living animal, and a myxinoid must after all be regarded as such, can lose its eyes through disuse would seem to be an impossible position."

With such useful things to say the author might, to the advantage of his readers, have lifted the veil rather oftener. Criticisms like that of the story of the pedigree of horses are refreshing and salutary, and we regret to learn from the preface that the author has deleted a number of them. We look forward to the fourth volume to reveal more fully the author's scepticism "as to the value of some hypotheses widely held as to the course of organic evolution." It need hardly be said that Mr. Sedgwick is "a convinced evolutionist"; he also believes in the importance of natural selection, even in regard to non-living things; but "as to the origin of the manifold properties of living matter we know nothing. The Darwinian theory did not account for properties; it left their origin to an imperfectly understood interaction between the organism and the environment, and further than this we cannot at present go."

In referring to the construction which must follow criticism, Mr. Sedgwick says :—

" That is the task of the great band of workers in many departments of Biology, who, undeterred by failure and urged on by the fire, enthusiasm, and generous aspirations of youth, return time after time, generation after generation, to the assault of the fortresses of nature well knowing that their material reward will be small, that defeat means the world's neglect and that success, except the greatest, brings but a pittance of its esteem. To them I inscribe this book in the hope that it may serve if only to a small extent to smooth over the difficulties of part of the road which at first they have to travel."

We may be allowed to thank the author for doing more than "smooth over" the difficulties of the road on which all students of zoology have to travel, for he has cleared away many hindrances and pointed out many pitfalls. It would serve little purpose, however, to enter into any discussion of the numerous morphological problems in regard to which Mr. Sedgwick has made some personal and luminous contribution. We feel that we have not said enough in regard to the excellence of his workmanship, but praise of what is masterly is gratuitous. The book's scholarliness, clearness, and carefulness of statement are obvious, but those who work with it will discover other virtues—a suggestive scepticism, a mature judgment, and a more indefinable quality which we can only hint at in the phrase "morphological insight."

*AN ESSAY IN HISTORICAL CHEMISTRY.  
The Study of Chemical Composition: an Account of its Method and Historical Development.* By Ida Freund. Pp. xvi+650. (Cambridge: The University Press.)

MISS FREUND is to be congratulated on having written a very interesting book. It is true that her subject-matter is to be found in many other quarters; she has really written a historical treatise on what is generally called stoichiometry; but having chosen as her title "The Study of Chemical Composition," she has left herself, so to speak, unfettered, and has been able to write somewhat more discursively than if she had compiled a treatise. Indeed, in the preface to the work she confesses :—

" Although anxious to trace separately the *historical development* in the discovery and in the establishment of certain laws and classes of phenomena, I have made no attempt to produce anything sufficiently complete or even sufficiently proportioned to deserve the name of *history*. I have preferred to deal in greater detail with a few researches, especially such as I could repeatedly utilise from various points of view, than to treat a greater number more cursorily, believing in what Lavoisier said more than a century ago that 'in such matters as these, the choice of proofs is more important than their number.' "

The result is a fairly full, indeed in some instances a very full, account of classical researches in the sphere to which she has confined her attention; the only omission is that of all reference to the laws of dilute solutions, and in this she was guided by the

fact that the subject has been recently fully treated in many works which are easily accessible.

Beginning with a sketch of the method of the inductive sciences, quotations from Bacon, Jevons, Kant, Whewell, and Mill are introduced, with illustrations of deductive reasoning by Kepler, Lavoisier, Davy and others, having as its basis classification, generalisation, and law. Next follows a fairly detailed study of the phlogistic theory, giving an excellent summary of the views held by the phlogistonists. Here Cavendish's reasons for his choice of the terminology of the phlogistic theory might with advantage have been inserted. Examples of Lavoisier's and Stas's work, and of Morley's synthesis of water are given to illustrate the basis on which the doctrine of the "conservation of mass" is founded. But laws may be of two kinds, exact and approximate; the difference is illustrated by Boyle's law and van der Waals's improved form. We do not notice, however, the remark that van der Waals's formula itself is only a rough approximation to the expression of the behaviour of gases under high pressures. Landolt's experiments, which may be now accepted as a proof of the accuracy of the constancy of mass, are cited; the reviewer does not know if Landolt has published the fact that his doubts disappeared only after he had used silica instead of glass vessels.

Affinity is the subject of the next historical sketch; here the views of Bergmann and Berthollet are very well summarised; and this naturally leads to the conception of fixed ratios by Proust, and the succeeding work of Dalton and Berzelius, with reference to the ideas contended for by Laurent.

The author now harks back to theories of matter, taking up the subject at its earliest start in India and Greece. The speculations of Bacon, Descartes, Gassendi, and Boyle are described, generally in their own words. Next follows a full account of Dalton's atomic hypothesis, of Gay-Lussac's law of volumes, and of Avogadro's generalisation. Berzelius's attitude towards the rival views is explained, and a clear account is given of the veteran Cannizzaro's successful attempt to obtain full recognition of the justice of Avogadro's views, so long overlooked. The determination of atomic weight by means of specific heat, and an excellent account of Mitscherlich's work and its latest development by Retgers (this last, so far as the reviewer knows, has not previously been accessible except in original papers), complete this part of the subject. The periodic arrangement of the elements, and its bearing on the determination of atomic weights, leads naturally to a consideration of the doctrine of valency, and Miss Freund has not omitted to state the attempts which have been made to represent valency in terms of the electronic theory. A chapter on isomerism follows, and the concluding chapter treats of the constitution of matter and the genesis of the elements.

From this sketch it will be seen that Miss Freund has brought together, in a compact form, a great deal of interesting matter. She has quoted freely from the authors whose views she presents, and, on